

Claims:

1. A method of monitoring and controlling manufacturing processes within a multi-step manufacturing system having independently operating tools that perform specific processes upon a workpiece, comprising:

testing a workpiece after one or more steps of processing within one or more independently operating tools;

generating control parameters for previous and subsequent processing steps that are to be performed or have been performed on the workpiece by the independently operating tools;

selectively supplying said control parameters to either the previous processing step or the subsequent processing step, or both to optimize the processing performed upon the workpiece.

2. The method of claim 1 wherein the workpiece is a semiconductor wafer and the independently operating tools are semiconductor wafer processing tools.

3. The method of claim 2 wherein the independently operating tools comprise one or more of: etch chamber, chemical-mechanical polishing tool, electrochemical plating cell, a physical vapor deposition chamber and a chemical vapor deposition chamber.

4. The method of claim 1 wherein said testing step is performed by at least one metrology station.

5. The method of claim 4 wherein said at least one metrology station performs blanket wafer tests and patterned wafer tests.

6. The method of claim 2 wherein said semiconductor wafer processing tools comprise an electrochemical plating tool and a chemical mechanical polishing tool.

7. The method of claim 6 wherein said testing step measures a uniformity and thickness of a layer deposited upon the semiconductor wafer using the electrochemical plating tool.

8. The method of claim 7 wherein said generating step produces control parameters for said chemical mechanical polishing tool comprising a pad rotational speed and a pad center-to-edge pressure profile.

9. A method of monitoring and controlling manufacturing processes within a multi-step integrated circuit manufacturing system having independently operating process tools that perform specific processes upon a semiconductor wafer, comprising:

testing a semiconductor wafer after one or more steps of processing within one or more independently operating tools;

generating control parameters for previous and subsequent processing steps that are to be performed or have been performed on the semiconductor wafer by the independently operating tools;

selectively supplying said control parameters to either the previous processing step or the subsequent processing step, or both to optimize the processing performed upon the semiconductor wafer.

10. The method of claim 9 wherein the independently operating tools comprise one or more of: etch chamber, chemical-mechanical polishing tool, electrochemical plating cell, a physical vapor deposition chamber and a chemical vapor deposition chamber.

11. The method of claim 9 wherein said testing step is performed by at least one metrology station.

12. The method of claim 11 wherein said at least one metrology station performs blanket wafer tests and patterned wafer tests.

13. The method of claim 9 wherein said independently operating process tools comprise an electrochemical plating tool and a chemical mechanical polishing tool.

14. The method of claim 13 wherein said testing step measures a uniformity and thickness of a layer deposited upon the semiconductor wafer using the electrochemical plating tool.

15. The method of claim 14 wherein said generating step produces control parameters for said chemical mechanical polishing tool comprising a pad rotational speed and a pad center-to-edge pressure profile.

16. A method of monitoring and controlling copper interconnect manufacturing processes within a multi-step copper interconnect manufacturing system having independently operating tools that perform specific processes upon a semiconductor wafer, wherein the tools include a barrier and seed layer deposition tool, a electrochemical plating tool and a chemical-mechanical polishing tool, comprising:

depositing a barrier and seed layer within a trench formed in the semiconductor wafer;

testing a barrier and seed layer thickness;

generating, in response to the barrier and seed layer thickness, first control parameters for the electrochemical plating tool and the barrier and seed layer deposition tool;

performing electrochemical plating to deposit a copper layer upon the barrier and seed layer in accordance with the control parameters;

testing a copper thickness and resistivity;

generating, in response to the copper thickness and resistivity, second control parameters for the electrochemical plating tool, the barrier and seed layer deposition tool, and the chemical-mechanical polishing tool;

performing chemical-mechanical polishing upon the copper layer in accordance with the second control parameters;

testing a copper uniformity and residue of the polished semiconductor wafer;

generating, in response to the copper uniformity and residue, third control parameters for the electrochemical plating tool, the barrier and seed layer deposition tool, and the chemical-mechanical polishing tool;

using the third control parameters in processing subsequent semiconductor wafers.

17. The method of claim 16 further comprising:

etching the trench into the semiconductor wafer;

testing a trench geometry;

generating, in response to the trench geometry, fourth control parameters for the electrochemical plating tool, the barrier and seed layer deposition tool, and the chemical-mechanical polishing tool;

using the fourth control parameters to process the semiconductor wafer having the trench geometry.

18. Apparatus for monitoring and controlling a multi-step semiconductor wafer processing system comprising:

a plurality of independently operating processing tools;

at least one metrology station for testing a semiconductor wafer after one or more process steps are performed by the plurality of independently operating processing tools;

a metrology data analyzer for analyzing data produced by the at least one metrology station and producing control parameters for said plurality of independently operating processing tools;

a plurality of process controllers for selectively applying the control parameters to the plurality of independently operating processing tools.

19. The apparatus of claim 18 wherein said at least one metrology station performs blanket and patterned wafer tests.

20. The apparatus of claim 18 wherein the independently operating processing tools comprise one or more of: etch chamber, chemical-mechanical polishing tool, electrochemical plating cell, a physical vapor deposition chamber and a chemical vapor deposition chamber.

21. The apparatus of claim 18 wherein the multi-step semiconductor wafer processing system produces a copper interconnect using independently operating processing tools comprising: a barrier and seed layer deposition tool, an electrochemical plating cell and a chemical-mechanical polishing tool.